

REMARKS

Claims 1-3, 5-13, 18-22, 24, 28, 30, 31, 38 and 39 are present and active in the application.

C/C composites are considerably stronger and lighter than steel. Such materials increase in strength with increasing heat treatment and resist thermal shock caused by rapid temperature change. However, they suffer from a number of drawbacks including poor oxidation resistance, highly variable wear rates and coefficient of friction, and costly manufacturing. Carbon fibers reinforcing a boron nitride matrix (C/BN composites) have the potential to overcome some of the shortcomings of C/C (Pat. No. 5,399,377), but do not have acceptable heat capacity and thermal conductivity to substitute for C/C composites in aircraft brakes, due to low density. The present invention mitigates this problem.

The present invention is directed to methods for manufacturing high density boron nitride composite materials, including: forming a mixture comprising borazine oligomer, and subjecting the mixture to a first heating. The first heating is at 60 °C to 80 °C, and at a pressure of at least 0.5 MPa. The composite material has a boron nitride matrix with superior density, providing a composite with superior properties. As claimed, the composites have a density of at least 1.62 g/cc.

The rejections of the claims under 35 U.S.C. 103 over Economy et al. in view of Spain et al. and in further view of Johnson, optionally in combination with Lavasserie et al., and/or Parlier et al., are respectfully traversed. Johnson does not describe the density of a boron nitride matrix composite.

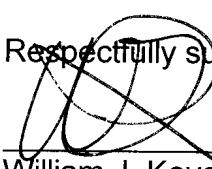
Johnson describes wear resistant articles. This reference teaches cutting segments of a carbonized fabric and laying them up until sufficient segments have been added to achieve a 20% fiber volume (paragraph [0028]). A central bung is removed and the assembly of segments is compressed to a predetermined volume in a suitable fixture (paragraph [0028]). The assembly is then infiltrated with carbon to a density of approximately 1.3 g/cm³ by chemical vapor infiltration; further infiltration is carried out until a disc density of over 1.8 g/cm³ is achieved (paragraph 38). The reference states that its invention is also applicable to boron nitride matrix (paragraph [0045]), but is silent as to the density, or any other details, of boron nitride matrix materials.

Economy et al. describes a maximum density for C/BN composites of 1.61 g/cc; density is a property of the composites which Economy et al. seeks to maximize. Spain et al. does not describe C/BN composites or their densities. Lavasserie et al. and Parlier et al. have been cited for elements of dependent claims.

As claimed, the present invention specifies a minimum density of 1.62 g/cc. Johnson discloses a carbon fiber material infiltrated with carbon, and is silent as the density, or any other details, of boron nitride matrix materials. Economy et al. describes a maximum density for C/BN composites of 1.61 g/cc. Spain et al. does not describe C/BN composites or their densities. Lavasserie et al. and Parlier et al. have been cited for elements of dependent claims. It is well recognized that the density of a material is dependent on its chemical composition and crystal structure. Consequently, even though Johnson states that its invention is also applicable to a boron nitride, the fact that a carbon matrix material is characterized by a certain density would hardly enable one of ordinary skill in the art to reach the conclusion that a boron nitride matrix material, that is a material of a different composition, is also characterized by the same density. Accordingly, applicants submit that the claimed invention is not obvious over the applied references. Withdrawal of these grounds of rejection is respectfully requested.

Applicants submit that the present application is now in condition for allowance. Early notice of such action is earnestly solicited.

Respectfully submitted,


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